



Survey on Postoperative Hypothermia Incidence In Operating Theatres of Kocaeli University

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Objective: Hypothermia is a common problem in anaesthetized patients and an important risk factor for mortality and morbidity. Our aim was to identify the incidence of hypothermia in our operating theatres. We also aimed to find the circumstances to which hypothermia could be related.

Methods: After obtaining the ethics committee approval and informed patient consent, patients with operation times longer than 30 minutes were included into the study for a one month period. Demographical data of the patients, type and duration of surgeries, temperatures measured pre and postoperatively from the tympanic membrane with an infrared thermometer were recorded. Temperatures below 35°C were accepted as hypothermia.

Results: A total number of 564 patients were enrolled to the study (305 women and 259 men). The ages of patients varied from 1 month to 84 years (mean 38.5±20.7). Hypothermia incidence was calculated as 45.7%. When the factors related to hypothermia were considered, age, type and duration of surgery and amount of fluids administered were found to be significant contributors to the development of hypothermia ($p<0.05$).

Conclusion: Postoperative hypothermia is a common problem in our clinic. Therefore, we suggest that temperature monitoring and patient warming should be a routine procedure during anaesthesia management.

Key Words: Thermoregulation, postoperative, hypothermia, temperature

Introduction

Postoperative hypothermia is a common but preventable problem in patients that underwent surgical procedures (1). It has been demonstrated that hypothermia is associated with increased mortality and morbidity rates, increases cost and reduces patient comfort by prolonging the duration of stay in the recovery room and hospital (2).

Various factors play a role in the development of perioperative hypothermia. Without temperature monitoring, it is not possible to detect hypothermia or to avoid its risks (2-4). International anaesthesia societies such as the American Society of Anesthesiologists (ASA) and the National Institute for Health and Care Excellence (NICE) recommend intraoperative temperature monitoring and active patient warming as standard practices (5, 6).

The present study aimed to investigate the incidence of hypothermia after surgical interventions performed in the central operating theatre of Kocaeli University. In addition, it also aimed to determine the likely correlation of demographic characteristics of patients, as well as anaesthesia- and surgery-related variables (age, gender, ASA status, room temperature, type of surgery, type of anaesthesia, kind and amount of fluids administered, and duration of intervention) with hypothermia.

Methods

After obtaining approval of Kocaeli Clinical Research Ethics Committee (2011/148, KAEK 16/1), patients scheduled to undergo surgical procedure within a month, between 29.02.2012 and 29.03.2012, with an expected surgery duration longer than 30 minutes and given consent were included in the study. Patients undergoing open heart surgeries and new-born surgeries, during which routine temperature monitoring is performed, and patients with ASA IV-V were excluded from the study. Information was recorded on the pre-prepared study form in the preoperative and postoperative period by the

same anaesthesiologist (Annex-1). Whilst, demographic data of patient were recorded in the first part of the form, information on surgical process was recorded in the second part, and preoperative and postoperative body temperatures were recorded in the third part.

In the preoperative period, demographic data and body temperatures of the patients were measured and recorded in the waiting room.

Body temperature was measured by the same anaesthesiology nurse through tympanic membrane using the same thermometer (*Genius 2, infrared tympanic thermometer, Mansfield, United States*). In the present study, a body temperature below 35°C was considered as hypothermia (1, 7).

Anaesthesia team that was responsible for the patient was not informed about the study to objectively observe the preferences and practices of anaesthesia specialists in Kocaeli University Faculty of Medicine, concerning perioperative temperature regulation.

In the postoperative period, type of surgery, type of anaesthesia, whether the patients were warmed in the perioperative period, the amount and kind of fluid administered, amount of bleeding, and whether temperature monitoring was available or not over the course of procedure were recorded from the perioperative anaesthesia recordings. In the postoperative period, body temperature of the patients was measured at the time of admission to recovery room. The time to discharge from the recovery room and whether shivering was present, were also recorded.

Temperature of the operation theatres were recorded for each procedure by room clerks, who were uninformed about the study, and the forms were delivered to the anaesthesiologist.

Type of anaesthesia was specified in three groups; general anaesthesia, neuroaxial anaesthesia and peripheral nerve block. Type of surgery was categorized as head and neck, chest and spine, open abdominal, closed surgeries, and extremity surgery. Recovery period was calculated from the time patient entered into the recovery room to the time Aldrete score became 10 (8).

Statistical analysis

At the end of the study, all data were transferred to the computer and statistical calculations were done using SPSS 16 program. Mean, standard deviation, minimum and maximum values of the data were calculated. Whether the data were distributed normally was assessed by Kolmogorov Smirnov test. Difference between the parameters that were distributed normally was analysed by Student's t-test, whereas the difference between the parameters non-normally distributed was analysed by Mann-Whitney U test. A $p < 0.05$ was considered statistically significant for all analyses.

Results

A total of 596 patients were included in the present study, which was conducted between 29.02.2012 and

29.03.2012. Thirty two patients were excluded during data collection period because of lack of data due to various technical problems. Finally, 564 patients, of whom 305 (54.1%) were female and 259 (45.9%) were male with ages ranged between 1 month and 84 years (38.45 ± 20.74 years) were included in the analysis. Demographic characteristics and ASA physical status of the patients according to whether they were hypothermic or normothermic are demonstrated in Table 1.

It was determined that 2.7% of the patients were hypothermic in the preoperative period. Distribution of body temperatures of the patients in the postoperative period is demonstrated in Figure 1.

Data and findings obtained from the patients were calculated depending on their body temperature's being over or below 35°C (Table 2).

Discussion

Hypothermia, which is frequently encountered in anaesthesia practice and may be ignored even though it is an important risk factor for morbidity and mortality, is defined as a body temperature below 36°C or 35°C (7, 9, 10). In the present study, we considered hypothermia as a body temperature below 35°C and evaluated the results accordingly.

In the present study, the incidence of hypothermia was found to be 45.7% among patients that underwent surgical intervention within one-month period in our operating theatre. Patients undergoing cardiac surgery and new-born surgical

Table 1. Demographic data and findings

	>35°C (n=306)	<35°C (n=258)	p
Gender (Female/Male)	174/132	131/127	>0.05
Age (years)	35.7±20.5	41.4±20.5	<0.001
BMI (kg m ²)	27.5±6.9	26.8±6.5	>0.05
ASA Physical status I/II/III:	200/93/13	159/85/14	>0.05
Data are presented as total number and mean±standard deviation. Mann-Whitney U test and Student's t-test were used for statistical analyses. BMI: Body mass index; ASA: American Society of Anaesthesiologists			

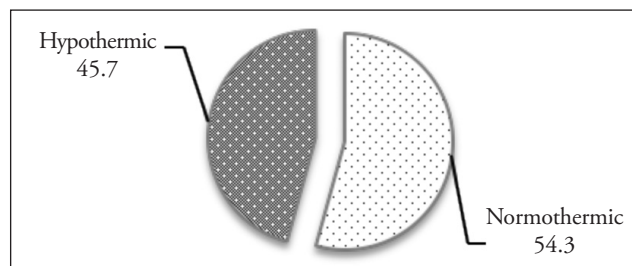


Figure 1. Incidence of Postoperative Hypothermia (n=564). The present study considered hypothermia as a body temperature below 35°C

interventions that routine warming and temperature monitoring are performed were excluded from the study. Nevertheless, hypothermia has appeared as a serious problem in this large series of 564 patients. We think that this ratio could be reduced by taking measures for situations that might lead to hypothermia and making regulations for temperature management.

Unpreventable heat loss despite necessary precautions is a frequent condition encountered in patients undergoing anaesthesia, regardless of the type of anaesthesia (3). The reasons for this heat loss have been defined in various studies and listed as follows; ASA III and IV patients (4), interventions concerning large body cavities (11), prolonged surgery duration (12), intraoperative excessive blood loss and fluid replacement (9), and a room temperature below 23°C (13). Our findings reveal similar outcomes. It is known that advanced age is another risk factor for hypothermia. In the present study as well, the mean age of hypothermic patients was significantly higher than that of the normothermic group (14). It should be kept in mind that

advanced age is an independent risk factor for hypothermia and temperature monitoring and perioperative warming must be routinely applied in such patients.

It is known that heat loss is higher and hypothermia is more frequent in long-lasting surgical procedures and in surgical interventions that involve large body cavities (11, 12). In the present study, we determined that hypothermia was more prevalent among patients that underwent thoracic or open abdominal surgeries, whereas normothermia was more prevalent among patients that underwent extremity surgery. With regard to the duration of surgery, we calculated the mean duration of procedure to be approximately 30 minutes shorter in normothermic patients in comparison to that in hypothermic patients.

Although body temperature has been suggested as a vital sign for a long time (15), a Europe-wide intraoperative temperature management study revealed that body temperature had been monitored in only 19.4% of the patients (2). Monitoring body temperature is mandatory to determine hypothermic patients. Temperature monitoring can be performed from different regions using various methods including invasive methods as well. Among non-invasive methods, nasopharyngeal temperature measurement is recommended as a reliable method (16). In our operating theatre, temperature measurements are performed from the nasopharynx, rectum, skin and tympanic membrane.

Today, many methods, either active or passive, are being used to warm the patients in order to prevent perioperative heat loss and hypothermia. In our operating theatre, patients are warmed using paper blankets, in which heated air passes through. Whilst it has been reported that Europe-wide 38.5% of patients are warmed in the perioperative period (2), this rate was 13.9% in the present study. The same study did not report the incidence of hypothermia; which was found to be 45% in the present study. Both the high rate of hypothermia and the low rate of warming indicate that patients are not warmed enough in the perioperative period; which leads us using the heating methods more frequently.

In the present study, preoperative hypothermia was detected in 2.4% of the patients. Using simple methods that reduce heat loss, such as active patient warming or covering patient with a blanket in the preoperative waiting period as well may be an option to prevent this. In a study, it was demonstrated that preoperative warming of the patients for 30-60 minutes reduces the incidence of perioperative hypothermia (17).

Whereas the mean time to reach the necessary Aldrete score for discharge from recovery room to the ward was 15 minutes for normothermic patients, we determined that the corresponding figure was 24.5 minutes for hypothermic patients. This approximately 10-minute difference was statistically significant. It has been reported that a 2 degrees decrease in the body temperature causes approximately 40 minutes delay in reaching the necessary criteria for discharge from the recovery room (18).

Table 2. Distribution of data according to the body temperatures of the patients

	Normothermic (n=306)	Hypothermic (n=258)	p
Room temperature: (°C)	23.5±1.4	23.2±1.6	0.003
Type of anaesthesia:			
General anaesthesia	208	217	<0.001
Neuroaxial anaesthesia	61	39	
Peripheral nerve block	37	2	
Type of surgery:			
Head and neck	79	72	0.025
Thoracic	8	14	
Open abdominal	61	55	
Laparoscopic	70	74	
Extremity	88	43	
Fluids administered:			
Total fluid (mL)	1251.9±830.9	1591.7±987	<0.001
Blood products (units)	0.016±0.1	0.108±0.5	0.012
Perioperative warming (Yes/No)	45/261	33/225	>0.05
Duration of surgery (minutes)	89.9±51.1	117.9±63.8	<0.001
Preoperative body temperature (degrees centigrade)	36.5±0.7	36.4±0.6	>0.05
Postoperative body temperature (degrees centigrade)	35.7±0.5	34.3±0.5	<0.001
Recovery period (minutes)	15.2±18.8	24.5±21.7	<0.001
Shivering:	48 (15.7%)	68 (26.4%)	0.002

Data are presented as total number, mean±standard deviation and percentages. Mann-Whitney U test was used.

Shivering is a common condition encountered in the postoperative period, which increases oxygen consumption and may lead to serious complications in high-risk patients. It may be encountered due to great variety of reasons, as well as hypothermia, and it is known to increase oxygen consumption by 300-400% (19). In the present study, we observed shivering in 26% of hypothermic patients and this was significantly higher than the incidence of shivering in non-hypothermic patients.

In our operating theatre, humidity and temperature of the environment is regulated via a central system using laminar flow and kept at a standard degree of 23°C. However, the temperature of surgery rooms can be adjusted depending on patient status and working comfort of the surgical team using room control devices. It is known that a room temperature lower than 23°C forms a basis for hypothermia (13). In the present study, the mean temperature of the surgery rooms was 23°C for both the hypothermic and non-hypothermic patients. Adjustable room temperature may provide advantage for patients that have high risk to develop hypothermia.

Study limitations

The primary aim of the present study was to determine the incidence of hypothermia in our operating theatre. For this purpose, data were collected without interfering with routine practices of surgery and anaesthesia teams. Not being able to obtain perioperative body temperatures of the patients can be considered as a limitation of the study in terms of collecting data on the development of hypothermia. Data collection period was considered as one-month and the number of patients was accepted as the number of all patients within this period excluding those warmed routinely. Although the results of the present study seem to be statistically significant and consistent with previous studies, not identifying sample size while determining the number of patients is another limitation of the study.

Conclusion

The present study revealed that hypothermia is an important problem in our operating theatre. Based on the results of the present study, we recommend monitoring body temperature, taking necessary measures to prevent hypothermia, and warming each patient that would undergo a surgical intervention, which is likely to last for more than 30 minutes. It would be more reasonable rather to prevent hypothermia in the perioperative period than treating hypothermia in the postoperative period.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Clinical Research Ethics Committee of Kocaeli.

Informed Consent: Written informed consent was obtained from patients who participated in this study.

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ANNEX-1. Survey for Incidence of Hypothermia in our Operating Theatre

Name-Last name:	File No:	Date:			
Gender: F / M Age:	Height:	Weight:	BMI:	ASA:	
Type of surgery:	Duration of Surgery:				
Anaesthesia technique:	GA (TIVA / SEVOFLURANE / DESFLURANE/ ISOFLURANE)				
Neuroaxial (Spinal / Epidural / CSE) Peripheral Nerve Block					
Blood loss:					
Amount of fluid administered:	Crystalloid:	Colloid:			
Amount of blood transfusion:	PRBC:	TDP:			
Room temperature:					
Has the patient been warmed:	Y	N			
At what degree:					
Method of warming:	Paper Blanket				
Temperature monitoring:	Y / N	Method: Rectal/Nasopharyngeal/dermal/tympanic			
Preoperative body temperature:	Body temperature at the entry to postoperative recovery room:				
Shivering at recovery room:	Yes / No				
Shivering treatment:					
Time to fulfilling the criteria for admission to the ward from recovery room (Aldrete 10):					
Temperature of the recovery room:					
Method of warming at the recovery room:	Blanket/Heater/Blanket+heater				